We claim:

1. An apparatus for determining the particulate content of an exhaust plume of a vehicle, comprising:

an ultraviolet light source for propagating through the exhaust plume ultraviolet light having a predetermined ultraviolet wavelength;

an infrared light source for propagating through the exhaust plume infrared light;

an ultraviolet light detector for receiving said ultraviolet light after passing through the exhaust plume and producing an ultraviolet signal representative of the reduction in intensity of said predetermined wavelength of ultraviolet light due to scattering by particles whose diameter is greater than said predetermined ultraviolet wavelength;

an infrared detector for receiving said infrared light after passing through the exhaust plume and producing an infrared signal representative of the reduction in intensity of the infrared light; and

a processor for determining from the ultraviolet signal the density of particles in the exhaust plume whose diameter is greater than said predetermined wavelength of ultraviolet light, and for determining from the infrared signal the density of carbon dioxide in the exhaust, said processor determining the particulate content of the exhaust by computing the ratio of the density of the particles whose diameter is greater than said predetermined wavelength of

ultraviolet light to the density of the carbon dioxide.

2. The apparatus of claim 1, wherein said predetermined wavelength of the ultraviolet light is substantially about .23 microns.

3. The apparatus of claim 1, further comprising a reference cell filled with a known quantity of carbon dioxide, and a reference cell detector for determining the reduction in intensity of a portion of said infrared light as different wavelengths are propagated through the reference cell, said reduction in intensity being due to absorption by carbon dioxide.

4. The apparatus of claim 3, wherein said infrared light source can be tuned to propagate infrared light of various wavelengths, and said infrared detector can produce signals representative of the reduction in intensity of the various wavelengths of infrared light that is propagated through the exhaust plume.

5. The apparatus of claim 4, wherein said processor calculates from the infrared intensities measured at various wavelengths the density produced by said infrared light source of the carbon dioxide in the exhaust plume and calculates as the particulate content, the ratio of the density of the particles whose diameter is greater than said predetermined ultraviolet wavelength to the density of the carbon dioxide, the ratio being characteristic of the relative density of the respective particles.

6. The apparatus of claim 5, wherein said processor calculates as another measure of particulate content, the ratio of the density of the particles whose diameter is greater than said predetermined infrared wavelength to the density of the carbon dioxide, the ratio being characteristic of the relative density of the respective

particles.

7. The apparatus of claim 6, wherein said processor calculates the average diameter of particles in the exhaust from the value of the particulate content ratio for the ultraviolet light divided by the particulate content ratio for the infrared light.

8. The apparatus of claim 1, wherein said predetermined wavelength of ultraviolet light is substantially about .23 microns and said predetermined wavelength of infrared light is substantially about 1.6 microns.

9. The apparatus of claim 1, wherein said predetermined wavelength of ultraviolet light is chosen so as to propagate through the exhaust plume without significant absorption.

10. A method of determining the particulate content of an exhaust plume of a vehicle, comprising:

propagating through the exhaust plume ultraviolet light having a predetermined wavelength;

propagating through the exhaust plume infrared light;

producing from ultraviolet light propagated through the exhaust plume an ultraviolet signal representative of the reduction in intensity of the ultraviolet light due to scattering by particles in the exhaust whose diameter is above the ultraviolet wavelength;

producing from infrared light propagated through the exhaust plume an infrared signal representative of the reduction in intensity of the infrared light in the exhaust;

determining from the ultraviolet signal the density of particles in the exhaust plume whose diameter is greater than said predetermined wavelength of the ultraviolet light;

determining the density of carbon dioxide in the exhaust plume; and

determining the particulate content of the exhaust by computing the ratio of the density of the particles whose diameter is greater than said predetermined wavelength of ultraviolet light to the density of the carbon dioxide.

11. The method of claim 10, further comprising providing a reference cell with a known quantity of carbon dioxide, and determining the reduction in intensity of a portion of said infrared light as different wavelengths are propagated through the reference cell, said reduction in intensity being due to absorption by carbon dioxide.

12. The method of claim 11, further comprising propagating infrared light of various wavelengths through the exhaust plume and producing signals representative of the reduction in intensity of the various wavelengths of infrared light.

13. The method of claim 12, further comprising calculating from the infrared intensities measured at various wavelengths produced by said infrared light source the density of carbon dioxide in the exhaust plume and calculating the ratio of the

particles whose diameter is greater than said predetermined ultraviolet wavelength to the density of the carbon dioxide, said ratio of the intensities being characteristic of the relative density of the particles.

14. The method of claim 13, further comprising calculating as another measure of particulate content the ratio of the density of the particles whose diameter is greater than said predetermined infrared wavelength to the density of the carbon dioxide, the ratio being characteristic of the relative density of the respective particles.

15. The method of claim 14, further comprising calculating the average diameter of particles in the exhaust from the value of the particulate content ratio for the ultraviolet light divided by the particulate content ratio for the infrared light.

16. The method of claim 10, wherein said predetermined wavelength of ultraviolet light is substantially about .23 microns and said predetermined wavelength of infrared light is substantially about 1.6 microns.

17. The method of claim 10, wherein said predetermined wavelength of ultraviolet light is chosen so as to propagate through the exhaust plume without substantial absorption.

18. An apparatus for determining the particulate content of an exhaust plume of a vehicle, comprising:

an infrared light source for propagating through the exhaust plume;

an infrared detector for receiving said infrared light after passing through

the exhaust plume and producing an infrared signal representative of the reduction in intensity of the infrared light; and

a processor for determining from the infrared signal the density of particles in the exhaust plume whose diameter is greater than said predetermined wavelength of infrared light and the density of carbon dioxide in the exhaust, said processor determining the particulate content by computing the ratio of the density of the particles in the exhaust whose diameter is greater than said predetermined wavelength of infrared light to the density of the carbon dioxide.

19. The apparatus of claim 18, further comprising a reference cell filled with a known quantity of carbon dioxide, and a reference cell detector for determining the reduction in intensity of a portion of said infrared light propagated through the reference cell at various wavelengths, said reduction in intensity being due to absorption by carbon dioxide.

20. The apparatus of claim 19, wherein said infrared light source can be tuned to propagate infrared light of various wavelengths, and said infrared detector can produce signals representative of the reduction in intensity of the various wavelengths of infrared light that is propagated through the exhaust plume.

21. The apparatus of claim 20, wherein said processor calculates from infrared intensities measured at various wavelengths produced by said infrared light source the density of the carbon dioxide in the exhaust.

22. A method of determining the particulate content of an exhaust plume of a vehicle,

comprising:

propagating through the exhaust plume infrared light;

producing from infrared light propagated through the exhaust plume an infrared signal representative of the reduction in intensity of the infrared light in the exhaust;

determining the density of carbon dioxide in the exhaust plume; and

determining the particulate content of the exhaust by computing the ratio of the density of the particles whose diameter is greater than said predetermined wavelength of infrared light to the density of the carbon dioxide.

23. The method of claim 22, further comprising providing a reference cell with a known quantity of carbon dioxide, and determining the reduction in intensity of a portion of said infrared light as different wavelengths are propagated through the reference cell, said reduction in intensity being due to absorption by carbon dioxide.

24. The method of claim 23, further comprising propagating infrared light of various wavelengths through the exhaust plume and producing signals representative of the reduction in intensity of the various wavelengths of infrared light.

25. The method of claim 24, further comprising calculating from the infrared intensities measured at various wavelengths produced by said infrared light source the density of carbon dioxide in the exhaust plume and calculating the ratio of the

particles whose diameter is greater than said predetermined infrared wavelength to the density of the carbon dioxide, said ratio of the intensities being characteristic of the relative density of the particles.

26. An apparatus for determining the average size of particles in an exhaust plume of a vehicle, comprising:

an ultraviolet light source for propagating through the exhaust plume ultraviolet light having a predetermined ultraviolet wavelength;

an infrared light source for propagating through the exhaust plume infrared light;

an ultraviolet light detector for receiving said ultraviolet light after passing through the exhaust plume and producing an ultraviolet signal representative of the reduction in intensity of said predetermined wavelength of ultraviolet light due to scattering by particles whose diameter is greater than said predetermined ultraviolet wavelength;

an infrared detector for receiving said infrared light after passing through the exhaust plume and producing an infrared signal representative of the reduction in intensity of the infrared light; and

a processor for determining from the ultraviolet signal the density of particles in the exhaust plume whose diameter is greater than said predetermined wavelength of ultraviolet light, and for determining from the infrared signal the density of particles in the exhaust plume whose diameter is greater than said predetermined

wavelength of infrared light, said processor determining the average diameter of the particles in the exhaust.

27. The apparatus of claim 26, wherein said predetermined wavelength of the ultraviolet light is substantially about .23 microns.

28. The apparatus of claim 26, further comprising a reference cell filled with a known quantity of a predetermined substance, and a reference cell detector for determining the reduction in intensity of a portion of said infrared light propagated through the reference cell at various wavelengths, said reduction in intensity being due to absorption by the predetermined substance.

29. The apparatus of claim 28, wherein said infrared light source can be tuned to propagate infrared light of various wavelengths, and said infrared detector can produce signals representative of the reduction in intensity of the various wavelengths of infrared light that is propagated through the exhaust plume.

30. The apparatus of claim 29, wherein said processor calculates from infrared intensities measured at various wavelengths produced by said infrared source the density of the predetermined substance and the density of particles whose diameter is greater than said predetermined infrared wavelength, and calculates as a first measure of particulate content, the ratio of the density of the particles whose diameter is greater than said predetermined ultraviolet wavelength to the density of the predetermined substance, and as a second measure of particulate content, the ratio of the density of the particles whose diameter is greater than said predetermined infrared wavelength to the density of the predetermined substance, the ratio being characteristic of the diameter of the particles.

31. The apparatus of claim 30, wherein said processor calculates from a ratio of the first measure of particulate content to the second measure of particulate content the average diameter of the particles in the vehicle exhaust.

32. The apparatus of claim 26, wherein said predetermined wavelength of ultraviolet light is substantially about .23 microns and said predetermined wavelength of infrared light is substantially about 1.6 microns.

33. The apparatus of claim 26, wherein said predetermined wavelength of ultraviolet light is chosen so as to propagate through the exhaust plume without significant absorption.

34. The apparatus of claim 26, wherein the predetermined substance is carbon dioxide.

35. The apparatus of claim 26, wherein said processor calculates a particle size index by subtracting the ratio of the density of the particles in the exhaust whose diameter is greater than the wavelength of said infrared light to the density of the particles in the exhaust whose diameter is greater than the wavelength of said ultraviolet light from one.

36. A method of determining the average diameter of particles in an exhaust plume of a vehicle, comprising:

propagating through the exhaust plume ultraviolet light having a predetermined ultraviolet wavelength;

propagating through the exhaust plume infrared light;

producing from ultraviolet light propagated through the exhaust plume an ultraviolet signal representative of the reduction in intensity of the ultraviolet light due to scattering by particles in the exhaust whose diameter is above the ultraviolet wavelength;

producing from infrared light propagated through the exhaust plume an infrared signal representative of the reduction in intensity of the infrared light in the exhaust;

determining from the ultraviolet signal the density of particles in the exhaust plume whose diameter is greater than said predetermined wavelength of ultraviolet light;

determining from the infrared signal the density of the particles whose diameter is greater than said predetermined infrared wavelength; and

determining the average diameter of particles in the exhaust by computing the ratio of the density of the particles whose diameter is greater than said predetermined wavelength of ultraviolet light to the density of the particles whose diameter is greater than said predetermined wavelength of infrared light.

37. The method of claim 36, further comprising providing a reference cell with a known quantity of a predetermined substance, and determining the reduction in intensity of a portion of said infrared light as different wavelengths are propagated through the reference cell, said reduction in intensity being due to absorption by the predetermined substance.

38. The method of claim 37, further comprising propagating infrared light of various wavelengths through the exhaust plume, and producing signals representative of the reduction in intensity of the various wavelengths of infrared light.

39. The method of claim 38, further comprising calculating from infrared intensities measured at various wavelengths produced by said infrared source the density of the predetermined substance and the density of particles whose diameter is greater than said predetermined infrared wavelength, and calculating, as a first measure of particulate content, the ratio of the density of the particles whose diameter is greater than said predetermined ultraviolet wavelength to the density of the predetermined substance, and as a second measure of particulate content, the ratio of the density of the particles whose diameter is greater than said predetermined infrared wavelength to the density of the predetermined substance, the ratio being characteristic of the diameter of the particles.

40. The method of claim 39, further comprising calculating from the ratio of a first measure of particulate content to the second measure of particulate content the average diameter of the particles in the vehicle exhaust.

41. The method of claim 36, wherein said predetermined wavelength of ultraviolet light is substantially about .23 microns and said predetermined wavelength of infrared light is substantially about 1.6 microns.

42. The method of claim 36, wherein said predetermined wavelength of the ultraviolet light is chosen so as to propagate through the exhaust plume without substantial absorption.

43. The method of claim 36, wherein said predetermined substance is carbon dioxide.

44. The method of claim 36, further comprising, calculating a particle size index by subtracting the ratio of the density of the particles in the exhaust whose diameter is greater than the wavelength of said infrared light divided to the density of the particles in the exhaust whose diameter is greater than the wavelength of said ultraviolet light from one.